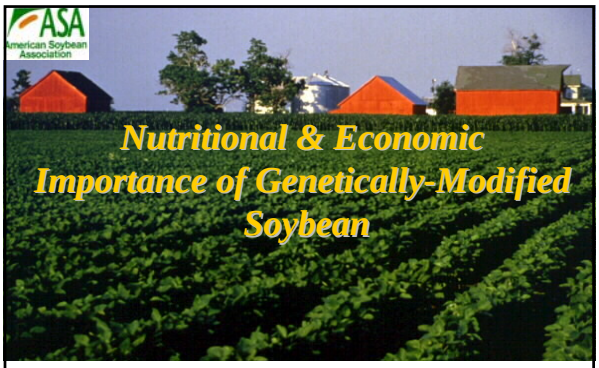


Basilisa P. Reas, DVM MSc
Technical Manager, ASA

Introduction:

- **Human population to reach 8-10 B by the middle of the next century;**
- **780 M suffering from malnutrition;**
- **In animal production, feed costs occupy the biggest input;**
- **Corn and soybean meal are major ingredients used**

Philippine Feed Industry, Jan. 2001

Total feed production/year	**7.5 MMT**
Registered Feedmill *(commercial production)*	**319**
Small scale (<20Mt/8 hr)	**162**
Medium (20 - 50 MT)	**74**
Large (>50 MT)	**83**
Poultry feeds	**50%**
Swine feeds	**35-38%**
Aqua (fish & shrimp)	**5-7%**
Others	**5%**

Source: BAI -AFSD, Jan 2001

Philippine imports of SBM

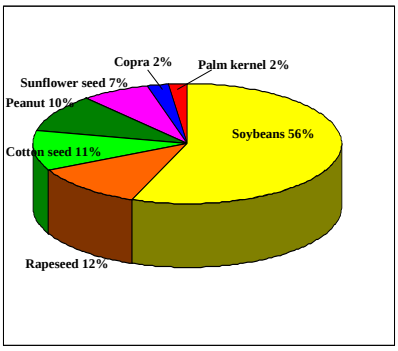
% Market share	1996-97	97-98	98-99	99-00	00-01
US, (dehulled only)	60.0	79.0	93.0	89.0	71.3
South America	3.0	5.0	3.0	7.0	24.3
South Asia, others	27.0	1.6	4.0	4.0	4.3
Total import, MMT	1,000.0	1,074.15	1,037.82	1,053.0	1,143.6

Amount of soybean and SBM imports US$ 166M/year

Top 8 US Soybean cake and meal export by country
1996 - 2001 (1,000 MT)

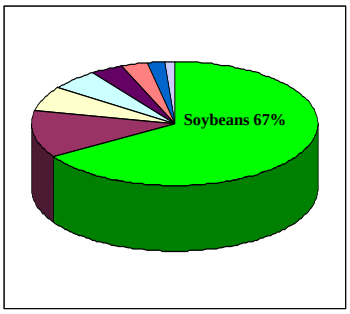
	2000-01		1999-00		1998-99		1997-98		1996-97	
COUNTRY	Exports	Rank	Exports	Rank	Exports	Rank	Exports	Rank	Exports	Rank
Philippines	808.6	1	921.9	1	1,001.3	1	799	2	465.4	3
Indonesia	779.2	2	258.1	7	-	-	659.6	3	58.5	24
Canada	712.2	3	715	2	703.5	2	169.2	15	586.4	1
Dom. Republic	352.1	4	345.5	3	262.5	7	249.1	12	230.2	6
Turkey	323.0	5	328.5	5	264.6	5	379.1	6	206.4	7
Saudi Arabia	317.5	6	335.8	4	257.3	8	480.2	4	416.9	4
Egypt	265.9	7	162.2	13	153.9	13	128.5	19	173.7	10
Thailand	242.0	8	257.5	8	224.8	9	83.1	27	151.4	14

World oilseed production, 2000



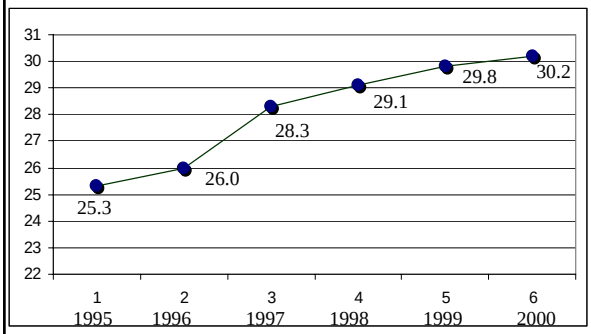
	MMT
Soybeans	171.5
Rapeseed	37.1
Cottonseed	33.1
Peanut	30.6
Sunflower	22.7
Palm kernel	7.0
Copra	5.7
	307.8

World Protein Meal Consumption 2000



	MMT	%
Soybeans	114.9	67
Rapeseed	21.4	12
Cottonseed	11.2	6
Sunflower	9.6	6
Fish	6.1	4
Peanut	5.4	3
Pal kernel	3.6	2
Copra	1.8	1
	173.9	

US Soybean area planted, ha:



What is Agricultural Biotechnology??

(Also called genetic engineering or gene splicing). A genetic modification that aims to further develop the already improved crops using selected desirable traits.

A specific gene or trait is used to improved a certain trait of an organism or crop. It is classified as modern biotechnology.

What is Genetically-modified crops?

These are plants spliced with a gene from another organism through biotechnological means.

GM-crops are produced with basic objectives of the following;

a.) crops protected against insect damage,
b.) herbicide tolerance for innovative farming.
C.) water quality (environment) protection, and
d.) protection against plant diseases.

Why Biotechnology??

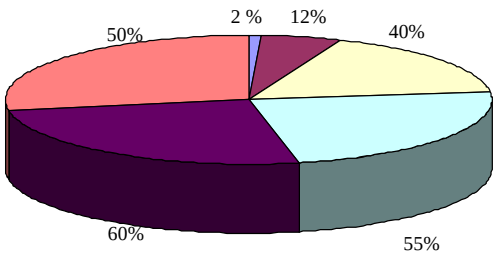
- ***Economics.*** **The demands for food, due to fast increasing population; reducing the costs of food and feed production by increasing the supplies;**

- ***Improvement of crops and increasing production.*** **And genetic modification techniques has the most promise.**

- **Benefit for the *environment;* producing products based on the *specific needs of the people* and providing a *safer food* to the increasing human population.**

Plantings of Genetically-Enhanced Soy in the US

(1996 – 2001)



Genetically-modified soybean now in the market:

Round-up Ready soybean Or Glyphosate Tolerant Soybean (GTS)

What are the benefits derived from GM soybean And GM corn?

EPA Categories for human carcinogens

Group A = Human carcinogen

Group B = Probable human carcinogen

Group C = Possible human carcinogen

Group D = Not classified as a human carcinogen

Group E* = Evidence of non-carcinogenicity for humans

*** Glyphosate classified in Group E**

Substantial Equivalence

- Compare food (or food components) from genetically modified crop to conventional counterpart
  - Origin of genes
  - Agronomic parameters
  - Composition (key nutrients / anti-nutrients)
  - Consumption

Confirmation of "substantial equivalence" equals… "as safe as"

Outcomes

- Substantially equivalent to conventional counterpart:

  no further testing

- Substantially equivalent to conventional counterpart except for introduced trait(s)

  focus assessment on trait(s) / gene product(s)

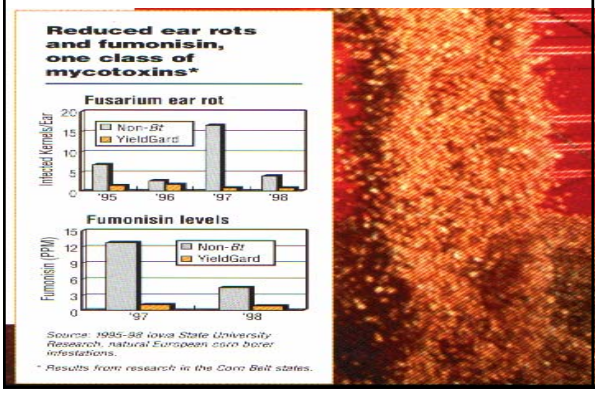
- Not substantially equivalent to accepted food or food component:

  combined nutritional / toxicological assessment

What are the benefits derived from GM soybean And GM corn?

- **More sustainable and resource –efficient crop management practices**
- **Less dependence on conventional pesticides that can be a health hazard to resource-poor small farmers in developing countries applying pesticides with hand sprayers**
- **Safer food and feed products, such as pest-resistant Bt maize which contains less mycotoxin than conventional maize**
- **Offer growers and society more efficient and higher crop productivity → ensure global food, feed and fiber security in the future**

What are the benefits derived from GM soybean and GM corn?



RR Soybeans are compositionally equivalent to conventional Soybeans

- **Based on the following components:**

1. **Amino acid composition**
2. **Fatty acid composition**
3. **Trypsin inhibitors**
4. **Lectins**
5. **Proximate analysis**

Cont.;

- **Based on the following components:**

6. **Phytoestrogens**
7. **Urease**
8. **Stachyose, raffinose**
9. **Phytate**
10. **N-solubility**

* ***Based on assessment of >400 components in 2000 independent analyses-J Nutrition 1996; 126:702-716; J Allergy Clin Immunol 1996,96: 1008-1010***

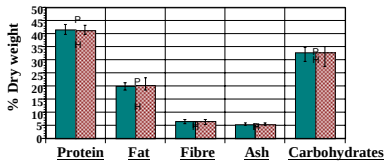
RR Soybeans are Compositionally Equivalent to Conventional Soybeans

Component	Beans	T Meal	Defat Flour	Isolate	Conc	RBDO
Proximate analysis	CE	CE	CE	CE	CE	
Amino acid comp	CE					
Fatty acid comp	CE					CE
Trypsin inhibitors	CE	CE	CE			
Lectins	CE	CE				
Phytoestrogens	CE	CE				
Urease	CE	CE	CE			
Stachyose, raffinose		CE				
Phytate		CE				
N-solubility		CE				

CE = Compositionally equivalent

- Based on assessment of over 400 components in 2000 independent analyses - J. Nutrition, 1996, 126:702-716
- Confirmed with soybeans treated with Roundup herbicide - J. Agri. Food Chem. (in press)
- Confirmatory macro analysis conducted in 1994, 1996 and 1998 (UK)
- No changes in endogenous soy allergens - J. Allergy Clin. Immunol. 1996, 96:1008-1010

Proximate Composition



4 field sites in 1993

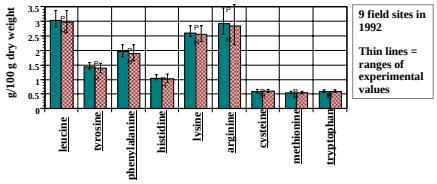
Thin lines = ranges of experimental values

Control seeds — Literature low

RRS seeds — Literature high

* No significant difference from the control line were observed at the 5% level (protected LSD).

Amino Acid Composition



9 field sites in 1992

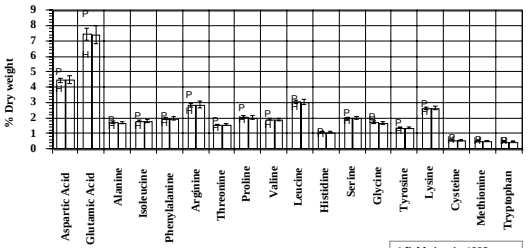
Thin lines = ranges of experimental values

Control seeds — Literature low

RRS seeds — Literature high

*No significant differences from the control line were observed at the 5% level (protected LSD).

Amino Acid Analysis of Seeds From Treated Roundup Ready Soybeans



Control seeds — Literature low

RRS seeds — Literature high

4 field sites in 1993

Thin lines = ranges of experimental values

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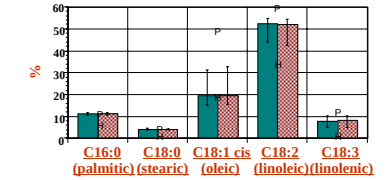
Fatty Acid Composition



9 field sites in 1992

Thin lines = ranges of experimental values

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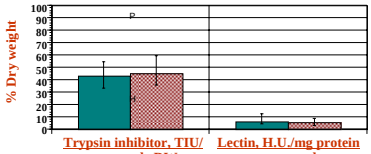
Toxicant Analysis



9 field sites in 1992

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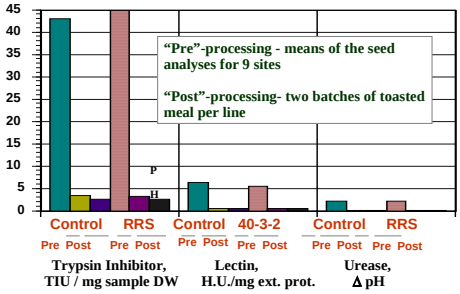
Processing



Compositional Analyses to Establish Substantial Equivalence (Corn Example)

Evaluate Key:
- Nutrients
- Vitamins
- Minerals
- Anti-nutrients
- Toxicants
- Allergens
- Others

List depends on crop

Grain	Forage
- Protein	- Protein
- Fat	- Fat
- Fiber	- Fiber
- Starch	
- Amino acid composition	
- Fatty acid composition	
- Ash	
- Sugars	
- Calcium	
- Phosphorous	

Comparison of Genetically- Enhanced Soy Detection Technique

PCR & related techniques	ELISA & related techniques
Detect DNA sequences on the basis of their uniqueness	Detect prot on the basis of their interaction with antibodies
No detection possible in the absence of DNA	No detection possible in the absence of protein
Are extremely sensitive	Are less sensitive
Needs very careful experimental set-up & data interpretation to ensure reliability	Are very reliable
Require the analysis of reference material	Require the analysis of reference material
Require standardization for sampling & extraction of material	Require standardization for sampling & extraction of material
Require detailed knowledge of the molecular structure of the introduced sequences	Require detailed knowledge of the molecular structure & of the physiochemical properties of the protein
Provides a qualitative yes/no answer; certain procedure allow quantification	Provide both quantitative & qualitative answers

From: van de Eede et. Al., 1999

Evaluation of High lysine/Protein SBM

	Protein%	Lys%	L/P%	Meth%	M+C%	NDF	TME kcal/kg
UI SBM	47.1	2.99	6.35	0.65	1.38	7.0	2193
M703	60.6	3.29	5.43	0.70	1.55	5.0	2388

From: Edwards et al., 2000

	Starter Diet			Grower Diet		
	Comm	GT Soy A	GT Soy B	Comm	GT Soy A	GT Soy B
	g/100 g dry matter					
Corn	58.0	56.9	58.1	63.7	62.8	63.7
Soybean meal						
Commercial	32.8	-	-	26.6	-	-
GT soy A	-	33.8	-	26.6	-	-
GT soy B	-	-	32.9	-	-	26.6
Soybean oil	4.0	4.2	4.0	4.7	4.8	4.6
DL-meth	1.5	1.5	1.4	1.6	1.6	1.5
Choline	0.003	-	0.003	-	-	-
L-lysine HCL	0.002	-	-	0.025	0.01	0.008
Limestone	1.4	1.4	1.4	1.3	1.3	1.3
Ca2PO4	1.6	1.6	1.6	1.5	1.5	1.5
Salt	0.5	0.5	0.05	0.05	0.05	-
Vitamins[2]	0.1	0.1	0.1	0.1	0.1	0.1
Minerals[3]	0.1	0.1	0.1	0.1	0.1	0.1
Energy, MJ (kcal)/kg	13.2 3155	13.2 3155	13.2 3155	13.6 3250	13.6 3250	13.6 3250
C. protein	20.80	21.40	20.80	18.10	17.97	18.31

Glyphosate Tolerant Soy: Broiler Performance Results

		Soybean Line		Sex	
	Commercial	GT Soy A	GT Soy B	Female	Male
Number	120	120	120	180	180
Body wt., g	2192	2188	2144	2104a	2309
Daily gain, g/d	51	51	50	48a	54b
Daily feed cons, g/d	93	93	92	88a	97b
Feed/gain, g/g	1.815	1.825	1.832	1.848a	1.799b
Livability, %	90.8	89.2	91.7	93.9d	97b
Breast wt., g	302	296	294	384a	311b
Breast/body wt., g/100g	13.8	13.5	13.7	13.9	13.4
Fat pad wt., g	81	82	77	85b	75a
Fat pad/body wt, g/100g	3.7	3.8	3.6	4.2a	3.3b

From Hammond et al., 1996

Comparative nutrient composition of DH conventional and RR SBM

De-hulled SBM,% ***(as fed basis)***

Item	Conventional SBM	RR SBM
Dry matter:	90.3	91.0
Crude protein	51.5	51.2
Crude fat	1.59	0.89
Crude fiber	3.41	3.12
NDF	4.95	4.85
ADF	3.50	3.94
Hemicellulose	1.45	0.91
Calcium	0.24	0.20
Phosphorous	0.73	0.83
Amino acids:		
Arginine	3.74	3.66
Histidine	1.44	1.40
Isoleucine	2.32	2.27
Leucine	3.96	3.89
Lysine	3.16	3.09
Methionine	0.70	0.71
Cystine	0.76	0.71
Phenylalanine	2.58	2.51
Tyrosine	1.80	1.76
Threonine	1.95	1.94
Tryptophan	0.77	0.75
Valine	2.44	2.43

From: Cromwell et a., 2002

Performance of pigs fed corn-DH SBM, conventional or RR ready SBM

ITEM	SEX				MEAN		
	Barrows		Gilts				
	Con'tnal	RR	Con'tnal	RR	Con'tnal	RR	CV
Soybean meal							
Initial weight	24.1	24.2	23.3	23.4	23.7	23.8	0.95
Final weight	110.8	113.7	108.6	110.2	109.7	112.0	3.34
Growing phase (23.7 – 54.5 kg)							
ADG, kg	0.83	0.85	0.80	0.80	0.82	0.82	4.77
ADFI, kg	2.02	2.13	1.94	1.96	1.80	2.04	6.71
Feed/gain	2.43	2.51	2.45	2.45	2.45	2.48	3.84
Early finishing (54.5 – 86.6 kg)							
ADG, kg	0.93	0.99	0.89	0.89	0.91	0.94	7.07
ADFI, kg	2.90	3.12	2.71	2.71	2.77	2..92	7.31
Feed/gain	3.13	3.17	3.06	3.06	3.05	3.11	6.04
Late finishing (86.6 – 110.8 kg)							
ADG, kg	0.78	0.80	0.75	0.82	0.77	0.81	10.1
ADFI, kg	3.04	3.08	2.81	3.06	2.93	3.07	3.00
Feed/gain	3.91	3.87	3.74	3.78	3.83	3.83	8.65
Entire test (23.7 - 110.8 kg)							
ADG, kg	0.85	0.88	0.82	0.83	0.83	0.85	4.96
ADFI, kg	2.64	2.76	2.43	2.52	2.53	2.64	6.11
Feed/gain	3.10	3.14	2.98	3.03	3.03	3.09	3.80

From: Cromwell et al., 2002

Value added soybean coming into the market;

TRAIT	YEAR	COMPANY	USE
High-Lysine	2006	DuPont Monsanto	Higher value & reduced-pollution soybean meal for animal feed.
High-Methionine	2006	DuPont Monsanto	Higher value & reduced-pollution soybean meal for animal feed.
High-Isoflavone	2006	DuPont	Healthier soyfoods (cancer prevention).
High-CLA	2006?	DuPont	Healthier soyfoods (cancer prevention). (Conjugated Linoleic Acid) Higher-value & reduced pollution sbm for animal feeds

Value added soybean coming into the market;

TRAIT	YEAR	COMPANY	USE
LoSat	1997	Pioneer	Premium (healthier) cooking oil. Half the saturated fat level of typical soybean oil.
Low-Linolenic	1997 2001?	Pioneer N.C. State	Premium cooking oil and for mayonnaise manufacture (more resistant to oxidation and time degradation).
High-Oleic (85%)	1997	DuPont	Heat-resistant cooking oil. High-value spray oil. Longer-shelf life oil for nuts, etc Heat-resistant lubricant. Higher-value soy protein (greater emulsion stability).

Value added soybean coming into the market;

TRAIT	YEAR	COMPANY	USE
Low- Stachyose	1998	Dupont	Sweet tasting foods Reduced pollution (min solids); High-energy SBM for feeds
Low-Phytate	2005?	Dupont	Reduced pollution for feeds
High-Phytase	2005?	Dupont? Monsanto? Pioneer?	Reduced pollution for feeds
High B-Conglycinin	2005?	Dupont	Protein w/ greater emulsion stability (protein-containing drinks

Summary:

- Ö **RR soybean – reduces herbicide use by 30%**
- Ö **Reduce ground water contamination**
- Ö **Facilitates no till farming**
- Ö **Use of low toxic herbicide**
- Ö **Reduces cost of soy products**
- Ö **Protecting the environment**

Bt corn:

- ❖ **Reduces 80% of chemical application against insects**
- ❖ **Higher yield**
- ❖ **Eliminates potential of mycotoxin contamination**
- ❖ **Safe**

Food security; Environmental protection; and; safety,,,,,

In giving our conclusion;

make assessment of the genetically – modified crops based on the product characteristics (quality) and not on the fact that these characteristics (quality)have been created by *biotechnology*. …